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ABSTRACT

This paper describes some practical lessons derived from the Managing Academic Tasks studies conducted at the Research and Development Center for Teacher Education at the University of Texas at Austin. The research included case studies of academic work conducted in 10 junior and senior high school science, mathematics, social studies, and English classes. Concepts and propositions that can improve understanding of classroom teaching and learning include: (1) cognitive level of academic tasks; (2) classrooms as production systems; (3) meaning in classroom work; (4) classroom processes; and (5) students' interpretation of academic work. Practical suggestions about how teachers handle problems of planning and conducting work include: (1) communicating tasks to students; (2) monitoring students' work; (3) encouraging students to engage in novel tasks; (4) making connections among classroom tasks; and (5) choosing task types and forms. The following procedures for observing academic tasks in classrooms are discussed: (1) identifying academic tasks; (2) pre-observation conferences; (3) observing classes; (4) describing tasks; and (5) postobservation conferences. (JM)

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Walter Doyle

Julie P. Sanford

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Walter Doyle

Julie P. Sanford

Research and Development Center for Teacher Education
The University of Texas at Austin

(R&D Report 6193)

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Abstract

This paper describes some of the practical lessons that can be derived from the Managing Academic Tasks (MAT) studies conducted at the Research and Development Center for Teacher Education at the University of Texas at Austin. This research included case studies of academic work conducted in 10 junior and senior high school science, mathematics, English, and social studies classes. Practical lessons from the research include first, concepts and propositions that can improve understanding of classroom teaching and learning and second, practical suggestions about how teachers can handle problems they face in planning and conducting work. Chapter I provides an overview of the research program and basic concepts used in the work; Chapter II summarizes findings concerning general properties of academic work in classrooms; Chapter III contains a discussion of specific problems in managing academic work and some suggestions for practice; and the final chapter focuses on procedures teachers and instructional supervisors can use to collect information about academic tasks in classrooms.

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Managing Students' Work in Secondary Classrooms: Practical Lessons from a Study of Classroom Tasks

I. Introduction

For the past few years, the staff of the Research on Classroom Learning and Teaching (RCLT) Program of the R&D Center for Teacher Education at The University of Texas at Austin have been studying a topic that is often neglected in educational research, namely, the nature of the academic work students do in secondary schools.[1] This research has been based on the proposition that academic assignments are the heart of classroom learning and teaching. Teachers' choices in planning and managing assignments determine in large measure the learning experiences students have, how they process classroom information and in the final analysis, what they learn. Therefore, the RCLT staff have been interested in describing the assignments teachers give and how these assignments are carried out by students in junior and senior high school science, mathematics, and English classes. Although a variety of classroom tasks were examined, special attention in these studies was given to assignments involving higher order thinking by students. Results of the studies have sugggested to us that attention to tasks as they are actually carried out in the classroom deserves a central place in consideration of effective teaching, and that without information about the task context of instruction, knowledge of specific teaching behaviors (e.g., questioning skills, clarity of presentation), student engagement rates, or topics of instruction in a particular class is of limited use. For supervisors, more attention to the way that academic work is enacted in classrooms will result in a more accurate

[1] For further information see Doyle, 1983; Doyle, Sanford, French, Emmer, & Clements, 1984; French & Sanford, 1985; Sanford, 1985.

and useful picture of the quality of instruction and the curriculum as it is being taught. For teachers desiring to improve their own teaching or teachers or supervisors engaged in assisting others to grow in their profession, academic task concepts and problems can provide a useful framework for thinking and talking about teaching.

The purpose of this paper therefore is to describe for teachers and for instructional supervisors some of the practical lessons that can be derived from this research. These practical lessons fall into two categories. First, there are concepts and propositions that provide a lens teachers and instructional supervisors can use to understand classroom events, diagnose problems that impede effective teaching and learning, and plan appropriate strategies to improve classroom conditions and increase student achievement. Second, there is specific information about problems that teachers face in planning and conducting work, and some suggestions about how these problems can be handled.

Chapter I of this report is designed to provided an overview of the RCLT research program, the basic concepts used in this work, and the classes included in the analysis. Chapter II consists of a summary of RCLT findings concerning the general properties of academic work in classrooms. Areas of special interest include the cognitive level of tasks, meaning in classroom work, and classroom processes that shape academic tasks. Chapter III contains a discussion of specific problems in managing academic work in classrooms and some suggestions for practice. Particular attention is given to problems in communicating tasks to students, monitoring students' understanding and work strategies, encouraging students to engage in novel tasks, making connections among tasks, and choosing task types and forms. The final

chapter focuses on procedures teachers and instructional supervisors can use to collect information about academic tasks in classrooms.

The Study of Academic Work

Before going very far, it is important to clarify what we mean by "academic work." To do that, we will first discuss a case that brings into focus the central issues involved in classroom studies of academic work and suggests the importance of the concept for understanding effective teaching. We will then define more formally the basic concepts that underlie the study of academic work.

An Illustrative Case

The following incident was observed in a high school English class being taught by a student teacher:

> Before class, the teacher had written on the left side board of the room a list of three characteristics of naturalist stories. When class began, the teacher announced that they were going to discuss Stephen Crane's story, "The Open Boat," and try to discover how the story reflected the three characteristics of naturalist writing. [This task, as announced, appeared to require knowledge of the story as well as analytical reasoning by students.] The actual "discussion" that unfolded was held between the teacher and two students sitting in the front and center of the room. The content of the discussion consisted mostly of students' descriptions of what the story was about. About five minutes into the discussion, the teacher commented, "Now we see how the first characteristic is illustrated in the story." At this point, a student sitting at the far right side of the room asked if this information was going to

be on the test. The teacher responded, "It would be well if you knew it."

At this point, a majority of the students took out pencils and paper and began writing. The focus of their attention, however, was not on the discussion, which continued between the teacher and two students. Rather, the class turned to the side board and began to copy down the information about characteristics of naturalist stories. In fact, near the end of the "discussion," a student asked the teacher what the last word of the third characteristic was. The only other time writing seemed to occur was when the teacher mentioned other examples from the story that corresponded to one of the three characteristics listed on the side board.

In this situation it seems clear that what students were doing was not shaped by the discussion they were supposed to be having or by the teacher's questions and reactions, but rather by their model of the work they had to do. Their behavior suggests some of the general features of this model: They would have to remember the information on the side board and the examples from the story that the teacher indicated were matched to that information. Of course, not all students appeared to participate in this process. Two of them engaged in this "discussion" with the teacher. Some never talked or wrote anything down. One can imagine they either intended to get notes from friends or did not care much about Stephen Crane, naturalist stories, or perhaps even school. And, presumably one or two thought of several other characteristics of naturalist writing and other examples from Crane's story and would eventually have trouble remembering which characteristics or examples the teacher wanted them to know.

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in Spring, 1983 (from mid-January until the end of February) in two science, two mathematics, and two English classes; and (b) 6 weeks of observations spread across a 2½ month period in Fall, 1983 (2 weeks beginning at the end of August and 6 weeks during October and November) in a team-taught combined English and social studies class for higher achieving students. Phase II of the research was conducted in two senior high school science classes and one senior high school English class. During Phase II 6 or 7 weeks of observation in each class were scheduled to track complete units of work from beginning to end.

For these studies special care was taken to select teachers who had good classroom management skills and who used a variety of tasks in their classes. Teachers were selected by (a) nominations from school district instructional coordinators, principals, and university supervisors of student teachers; and (b) screening observations by members of the RCLT staff. For Phase I, teachers in mathematics and English classes were also screened by empirical evidence of effectiveness in terms of class mean achievement gain over the previous 2 years. One class for each teacher was chosen for observation and analysis.

Only a few classes were studied because of the large amount of information that needed to understand tasks and work systems in each setting. Data for the analysis of academic tasks consisted of daily observational records focused on classroom events and processes related to assignments, copies of materials used in class (e.g., textbooks, work and assignment sheets, tests), and completed student work after it had been graded by the teacher. In addition, teachers and selected students were interviewed to explore how they talked about and understood the

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work being done in the classes. (See the last section of this report for a description of procedures for collecting data about academic tasks in classrooms.)

Some Basic Concepts

The RCLT program of research was based on the premise that the curriculum exists in a classroom in the form of the academic tasks teachers assign students to accomplish. A task consists of:

1. A product, such as words in blanks on a worksheet, answers to a set of test questions, an oral report in class, or an original essay;

2. Operations to product the product, for example, copying words off a list, remembering words from previous lessons, applying a rule (such as "Distributive expressions--none, each one, nobody--take singular verbs) to select appropriate words, or formulating original sentences to compose a descriptive paragraph;

3. Resources, such as notes from lectures, textbook information, conversations with other students, or models of finished products supplied by the teacher;

4. The significance of "weight" of a task in the accountability systems of a class; for example, a warm-up exercise in math might count as a daily grade, whereas a unit test might equal 20% of the grade for a term.

The concept of "task," in other words, calls attention to four aspects of work in a class: a goal state or end product to be achieved; a problem space or set of conditions and resources available to accomplish the task; the operations involved in assembling and using resources to reach the goal state or generate the product; and the importance of the task in the overall work system of the class.

Teacher affect tasks, and thus what students learn, by describing specifications for assignments, providing explanations about the processes that can be used to accomplish work, serving as a resource while students are working, and managing accountability for products. The central element in teaching, however, is the way teachers define and structure the work students are to do. It is here that the curriculum is translated into concrete events for students and a context is created for interpreting information during class sessions and for thinking about subject matter.

Brief Descriptions of the RCLT Classes

Although only a few classes were used in the RCLT studies, the total number of tasks was large: Approximately 400 tasks were accomplished in the 10 classes. Some general task forms were seen across several classes: text or ditto assignments in which students read a selection of text and then responded to questions; routine review or practice exercises; laboratory experiences with corresponding reports and questions; tests assessing recall-level objectives; tests requiring comprehension and application operations; and compositions, including research reports. On the other hand, there was considerable variety across classes in the number and kind of tasks observed. Students in one math class completed 49 tasks, while students in one science class completed only 14 tasks, with 80% of the total task time in this class devoted to only 6 tasks.

To provide a perspective on the character and variety of the tasks we analyzed, we will briefly describe the classes included in the RCLT studies.

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Teacher 1

Teacher 1 taught an eighth-grade combined life, earth, and physical science course. The class of 25 was heterogeneous with regard to prior academic achievement and ethnicity. It met in a large, well equipped room that included both a regular classroom desk arrangement and six laboratory tables for student lab activities. This class was characterized by relatively few tasks (14) and included several long-term assignments, many laboratory experiences and class discussions, and an emphasis on development of problem-solving and reasoning skills. Students who wanted a B in the class could complete, out of class, one of three optional or extension tasks, and those wanting an A had to complete one of three additional tasks (only 12 of the 25 students completed one or more of these assignments). The content of tasks during the period of observation focused on two related units: (a) the metric system and laboratory measurement (six tasks) and (b) scientific research methods (8 tasks).

Teacher 2

In Teacher 2's seventh-grade English class, there were 12 boys and 17 girls of varying achievement levels. Teacher 2 used 17 tasks to teach grammar, spelling, punctuation, and writing. Spelling assignments were taken primarily from the textbook. For grammar and punctuation, Teacher 2 generally explained the rule, provided models of correct usage, and had students complete short exercises (e.g., sentence completion). Writing assignments usually followed a prescribed format and sometimes incorporated spelling words, specific grammar aspects and/or punctuation that had recently been studied in the class.

Teacher 3

In Teacher 3's eighth-grade English class there was a wide range of achievement levels, and the teacher made a special effort to assist lower ability students and encourage their participation in whole-class lessons. Spelling and grammar formed the core of the instruction program for this 6-week term. Spelling tests were part of the regular weekly routine, and a test of 50 words drawn from weekly units was given at the end of the term for a major grade. Grammar instruction focused on pronoun and verb usage, and the teacher devoted a large amount of time to teaching specific algorithms for selecting the correct form of pronouns and verbs. In addition, she provided ample opportunity for practice and review. Writing instruction consisted of daily entries in journals and a "perfect paragraph," that is, a paragraph could be handed in up to four times for feedback before a final grade was given. Finally, the teacher required students to correct all graded work and keep it in notebooks. At the end of each term, they were given a notebook test for which they were expected to be able to retrieve specific information about items on assignments and tests.

Teacher 4

Teacher 4 taught an average-ability eighth-grade math class. The content covered during the observation period included ratios, proportions, and percent. At the end of the observation period, students were expected to be able to solve word problems with proportions, discounts, sales tax, and interest rates. Concepts were introduced by the teacher in class and numerous models presented. Students practiced the concepts in a variety of seatwork and homework assignments that were checked and reviewed in class.

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Teacher 5

Teacher 5's seventh-grade math class was an average-ability class, but included several outlying low or high achieving students. During the observation period, the teacher introduced the concept of percent in very small steps. Students completed a large number of tasks providing practice on each new skill or concept. In addition, they had daily assignments designed to reinforce and evaluate skills taught earlier in the year.

Teacher 6

The final class included in the Spring, 1983 data collection was an eighth-grade science class of 28 taught by Teacher 6. Students in this class completed a large number of tasks related to the circulatory and digestive systems. Typical tasks required students to read a passage and answer questions, do laboratory activities and record procedures and findings, or identify structures. In addition, all students were required to complete a science fair project during the observation period.

Teachers 7 and 8

Teachers 7 and 8 taught as a team in a combined social studies and English class for high achieving students. This was a 2-hour seventh-grade honors class that included 31 students. Course objectives emphasized acquisition of critical thinking skills, such as skills used to compare and contrast events and issues, distinguish fact from opinion, identify different points of view, and analyze cause-and-effect relationships. Fifty-eight tasks were assigned during the observation period, which included the first 2 weeks of school and 4 weeks during which an integrated unit on Indians of Texas was accomplished. The

content covered included vocabulary, grammar, environment and culture of Indians and peoples of Texas, environmental influences on culture, current events, and Texas government. Assignments required students to write paragraphs and letters, take notes and do independent literature searches, and work in groups to plan and present projects.

This class was selected in an effort to increase the possibility of being able to observe higher-level tasks. In addition, the study of this class represented a methodological advance for us. In early classes, observations were done for a 6-week grading period in the middle of the school year. In this class we started observations at the beginning of the year and then focused on a specific unit of work that appeared to offer an opportunity for studying a range of tasks. In this case, we selected a 4-week unit on Indians of the region because it consisted of several tasks from map drawing to making a collage to writing a descriptive and an analytical paragraph. Finally, we invested more time and energy to gather information about how students thought about the tasks they were accomplishing.

Teacher 9

Teacher 9's class was an honors section of first-year biology. There were 20 students in the class, including 7 freshmen and 13 sophomores. The honors biology curriculum required an emphasis on reasoning processes and independent study skills. Students' standardized achievement test scores from the previous year ranged from the 69th to the 99th percentiles, with half of these students scoring in the 90th percentile or above and only one scoring below the 75th. Teacher 9 was an experienced teacher who taught both chemistry and

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biology and who participated in the development of the school district's honors biology curriculum.

Teacher 10

Teacher 10's biology class, although designated as an honors section, had a heterogeneous student body. It was located in an integrated school with a reputation for excellence in science education. There were 26 students in the room, including 12 freshmen, 12 sophomores, and 2 juniors. Students' standardized reading and mathematics achievement test scores from the previous year ranged from below the 20th to the 99th percentile, with five students having math scores below the 75th percentile and nine having reading scores below this level. Teacher 10 was an experienced teacher and department chairperson. She participated in the design of the honors biology curriculum for the district.

In both Teacher 9's and Teacher 10's classes, a unit focusing on human genetics was observed. Science educators consider genetics as fundamental to the secondary biology curriculum and as a topic that is relatively difficult for students to learn. The stated goals of the honors curriculum included development of independent study skills and higher order cognitive processes. The units observed included a variety of assignments and activities covering the topics of cell reproduction and self-perpetuation and including concepts related to the nature of genetic material, principles of heredity, genetic and environmental interactions, and evolutionary mechanisms. In both classes students completed many laboratory activities, text assignments and quizzes; solved pedigree problems; and conducted independent research projects on a variety of topics.

Teacher 11

Teacher 11 taught an 11th-grade English class of 25 students whose standardized test scores ranged from the 20th percentile to the 80th percentile. The junior English curriculum, which Teacher 11 helped to develop, placed a heavy emphasis on writing, although grammar, vocabulary, and literature were also included. Observations in this class focused on three units: a 2-week "descriptive essay," a 2-week "argumentative/persuasive essay," and a 3-week "expressive essay." For each of these writing units, students' products, the procedures through which they were produced, and the resources available to aid students were highly structured and explicitly defined. The teacher also gave multiple assignments at the same time so that students could choose the order in which they completed their work.

Conclusion

These descriptions complete the picture of the RCLT studies upon which this report is based. In the next section, we present some general concepts and propositions about academic work that emerged from our analyses. These general notions are especially useful in helping teachers and instructional supervisors understand how work gets done in classrooms and what features of classroom life to examine in working to improve instruction.

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II. General Properties of Academic Work in Classrooms

We now turn to the findings of the RCLT studies of classroom tasks. We begin with a description of some of the general properties of academic work in classrooms. Attention in this chapter is focused on the different types of academic tasks that occurred in the classes. Special attention is given to the cognitive processes that underlie these tasks and the management processes associated with their actual use in classroom settings.

Cognitive Level of Academic Tasks

The cognitive level of an academic task refers to the cognitive processes students are required to use in accomplishing it. In the following discussion we will attempt to clarify this notion and describe the way in which tasks at different levels were represented in the RCLT classes.

Some Basic Terms

For many tasks, memory is the primary route to finishing the work: Students are required to reproduce or recognize information that they have already seen. Spelling is a good example of memory level work. For other tasks, students have to use formulas or standardized procedures, such as grammar rules or mathematical operations, to generate answers to a set of problems. The RCLT studies (and others--see Mitman, Mergendoller, Packer, & Marchman, 1984) also indicate that students sometimes use a search and match strategy in which they identify passages in text that correspond in some general way to "study" questions or to the requirements for a paragraph or essay. They then need only to copy or paraphrase the text.

Tasks based primarily on memory, formulas, or search and match strategies are quite common in classrooms. In the RCLT studies, much of the work in English, math, and science classes was based on reproduction of information or the application of standard formulas to predictable instances.

Most curriculum guides, however, emphasize the importance of higher cognitive processes such as understanding and transfer. At their core, higher cognitive processes involve decisions about how to use knowledge and skills in particular circumstances to generate a product. A task demanding higher cognitive processes might require students to recognize transformed versions of information or of a formula they have already learned. For example, students might be asked to describe how climate affected culture for Indian tribes other than the ones discussed in the textbook. At more advanced levels, students might have to (a) select an operation or combination of operations to solve word problems in math, (b) draw inferences from information given to formulate new propositions or hypotheses, or (c) plan a goal structure for a complex writing assignment. The focus in tasks involving higher cognitive processes, then is on comprehension, interpretation, flexible application of knowledge and skills, and assembly of information from several different sources to accomplish work.

Greeno (1983) described an instructive example of a higher level cognitive processes in mathematics, namely, the process of constructing a semantic representation of word problems (a similar case in science has been described by Heller, Reif, & Hungate, 1983). He summarizes evidence suggesting that students who are successful in solving word problems follow two steps. First, they "form intermediate

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representations that include relations among the quantities in a problem" (Greeno, 1983, p. 7). In other words, they translate the original description of the problem into a schematic diagram that contains the major elements of the problem and how they are related to one another. Using this diagram, they then decide which equation or procedure can be used to compute an answer. Less successful students, on the other hand, skip the first step and begin by trying to select the computational procedure that appears to match the problem.

Unfortunately, mathematics teachers often neglect interpretative analysis and strategic decisions in structuring academic tasks for their classes. They focus instruction, rather, only on computational procedures and accuracy of calculations. In addition, in some classes students are always told in advance which formulas or equations they are to use in solving problems. As a result, they have limited opportunity to formulate semantic models of problems. Under such circumstances, it is unlikely that students will learn when to use computational skills or how to apply them to unfamiliar situations.

Familiar Versus Novel Work

In its classroom forms, academic work can be divided into two broad categories: familiar and novel. Familiar work consists of routinized, recurring exercises--spelling tests and grammar worksheets in English, warmups and problem sets in mathematics, vocabulary lists and laboratory projects in science--in which relatively standardized operations or algorithms are used to generate products. In some instances, the work is quite difficult, involving fairly complex operations, as in Teacher 4's eighth-grade math class. But the work is predictable: that is, there is little ambiguity about what to do and how to do it and

little risk that things will go wrong along the way. In most of the classes we studied, familiar work accounted for approximately two thirds of the tasks students accomplished.

Novel work, on the other hand, consists of assignments for which students are required to assemble information and operations from several sources in ways that have not been laid out explicitly in advance by the teacher. Novel tasks in math, for example, would involve such processes as combining algorithms already learned into a chain of operations to solve a particular problem. Writing projects in English and hypothesis generating and testing experiments in science are also examples of novel work. The essential features of novel work is that students must make decisions about what to produce and how to produce it. These are the assignments in which teachers struggle to get students to "think for themselves." In tasks structured for student decisions, predictability is low and cognitive and emotional demands are high because there is more ambiguity about products and operations and greater risk of missing the mark. Although they can provide prerequisite instruction, teachers cannot give students explicit demonstrations, exact models, or familiar routines to follow for these tasks, without greatly reducing the amount of intellectual work students do and thus, the opportunities they have to practice higher-order operations.

Summary

This discussion of cognitive level suggest that curriculum content can be represented in classrooms in a variety of fundamentally different ways. For example, writing can consist of having students either combine short sentences to form more complex expressions or struggle to

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express their own interpretation of a story or a historical incident. Similarly, problem solving might involve applying a standard and predictable computational procedure to a set of 20 arithmetic problems or deciding which mathematical language adequately represents a scientific process in an experiment. Clearly a list of topics a teacher intends to cover in class gives only minimal information about the actual curriculum in use in the class. To understand and improve the opportunities students have to learn the curriculum, it is necessary to examine the tasks a teacher requires them to accomplish with content. Indeed, research on academic tasks provides a language for teachers and instructional supervisors to talk about the content of their classes in terms of the assignments made, the resources available to students, and the degree of accountability for work.

Classrooms as Production Systems

Some of the classes we observed seemed to be designed primarily for the efficient production of academic work, that is, a great deal of student work was accomplished with a high degree of work involvement from nearly all students. These high-production classes were often organized around routinized work patterns, such as warm-ups in math classes and recurring journal writing segments and spelling assignments in English classes. In addition, work was typically defined quite explicitly and students were given a great deal of guided practice with problem types.

Tasks in high-production classes are often highly familiar, and students are seldom required to assemble information or processes in ways that have not been repeatedly demonstrated to them in advance. Content is divided into small chunks, instruction is step-wise, progress

through the curriculum is rapid and efficient. In addition, there is *often little differential weighting of credit for different tasks.* All tasks are equal, and final term grades are calculated by averaging grades on individual tasks. Finally, tasks in high-production classes are often interchangeable. That is, while there may be a broad sequence (e.g., addition before multiplication or fractions before decimals), the ordering of tasks for a day or a week is somewhat arbitrary. Decisions about the order of tasks are based, it appears, on management considerations, personal preferences, or need rather than on a logical or semantic thread that ties the separate tasks together.

Teacher 5's seventh-grade math class exemplified a high-production curriculum. During the observation period of 6 weeks, students completed a large number of tasks providing practice on each new skill or concept. In addition, they had daily assignments designed to reinforce and evaluate skills taught earlier in the year. The teacher used four main types of tasks: application tasks (warm-up problems requiring different skills), reinforcement tasks (guided practice on new skills), review tasks (covering a skill learned earlier in the year), and assessment tasks (tests in which students demonstrated attainment and retention of skills). Several content strands involving operations with whole numbers, fractions, and decimals operated simultaneously and were encountered on a variable schedule. These strands constituted the "old" content covered previously. "New" content involving the conversion of fractions to decimals, decimals to fractions, and the introduction of percent were worked into the curriculum in small segments and practiced along side the old content. However, students were held accountable during a particular grading period only for

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mastery of the old content. During the 6 weeks we observed, students never attempted "word" problems, which would have required them to select among or integrate different operations. In sum, the math curriculum in this class appeared as a set of somewhat discrete skills that needed to be practiced and mastered independently, and the emphasis was on computation rather than on math concepts.

In Teacher 6's eighth-grade science class, production was high but concept development across the term did not seem to follow a clear logical progression. Students in this class completed 30 tasks related to aspects of the circulatory and digestive systems, and engagement was high throughout the term. Typical tasks required students to read a passage and answer questions, do laboratory activities and record procedures and findings, or identify structures.

Activities in Teacher 6's class ran very smoothly, and students were quite productive. The work itself, however, had three distinctive characteristics. First, virtually all tasks were accomplished within one or two class periods, and each counted as only a very minor portion of the grade for the 6 weeks. Second, all tasks were self-contained, that is, the information necessary to complete the work was given within the materials for a task so that integration or assembly across tasks was unnecessary. Moreover, the teacher did not overtly tie lectures to laboratory or worksheet tasks. Finally, the ordering of tasks was arbitrary. Units did not begin with an introduction and lead to a logical culmination. Rather, tasks covering parts of the unit were assigned before the introductory lecture, and textbook summaries of units were scheduled after several discrete tasks were already

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completed. All the information was there and repeated often, but tasks were treated as independent and interchangeable pieces.

One gets the impression that Teacher 6's class was driven by the logic of classroom management (i.e., keeping students engaged in work) rather than the logic of the content. Tasks appeared to be scheduled on the basis of how work segments fit into the timeframes of class sessions or how topics appealed to students rather than how they were meaningfully connected. The students did a great deal of science-like work--labs, worksheets, textbook readings, etc.--but it was not clear that any overall meaning was built into the system. It is interesting to note that students were apparently not bothered by a lack of content progression or integration. Their contentment could have resulted from the fact that there was an inherent logic to the work system: Tasks were explicit, predictable, and easy to accomplish.

Meaning in Classroom Work

In most of the classes we observed, we seldom saw students accomplish tasks in which they were required to struggle with meaning. Of course, they often struggled with the meaning of work: What were they supposed to do, when did they have to finish, what was the answer to the fifth item, etc. But meaning itself was seldom at the heart of the academic tasks they did. Grammar usually consisted of selecting one of two words in parentheses that seemed to sound right rather than an effort to express a thought accurately and clearly. Literature often involved memorizing facts of a story, expressing an opinion, or learning the standard interpretation of a passage rather than groping to understand what the story or poem meant or how an author tried to communicate that meaning. And writing frequently required students to

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follow a format to construct a text that had a specified number of adverbs and transition words rather than an occasion to communicate ideas.

The problem of meaning in classroom curricula is serious for two reasons. First, most curriculum guides place high value on understanding and meaning. We want students to understand subject matter and be able to apply it flexibly to novel situations. Few opportunities are provided in classroom work systems, however, for students to engage in this type of activity with subject matter. Second, there is some evidence in our work and that of other investigators (see Anderson, 1983; Davis, 1983; Eaton, Anderson, & Smith, 1984) that production and understanding are not necessarily connected. Students may practice computational algorithms or follow procedures for carrying out experiments with plants or light, but fail to understand the mathematical or scientific principles that underlie the exercises and often retain or form misconceptions of these principles. They may be able to tell someone how to get an answer to a problem but not what the problem means.

Recent studies have underscored the principle that problem solving in academic subjects is not simply a matter of skill. To solve academic problems students need domain-specific knowledge in the subject area. Chi, Feltovich, and Glaser (1981), for example, examined differences between novice physics students and expert physicists in sorting physics problems by types. They found that experts were able to use their understanding of abstract physics principles to interpret problems in terms of underlying principles not explicitly stated in the problem texts. Novices, on the other hand, attended to isolated details and

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failed to make key inferences about the meaning of problems. The investigators concluded that the difficulties novices had stemmed largely from deficiencies in their theoretical knowledge of physics and how it is represented in problem situations.

Along similar lines, Heller et al. (1983) have argued from their research on problem solving in physics that, in addition to specific computational procedures, students need to be taught the domain-specific knowledge required for understanding problems, constructing problem descriptions, and selecting principles and concepts to apply to particular cases. They further suggest that teachers clearly explain the processes involved in arriving at a solution strategy, have students formulate problem descriptions and think aloud as they solve problems, provide coaching and guidance while students practice problem solving, construct tasks that emphasize the qualitative or interpretative components as well as the computational aspects of problems, and test students for understanding and reasoning processes.

At the level of classroom practice, a concern for meaning would also require that a teacher focus explicitly on the semantic thread that ties tasks together across separate class sessions. When students are studying topics that extend across several days, such as the nature of the scientific method or the operations of the circulatory system, a teacher needs to describe the connections between lessons in order to build broad understandings of content and place individual tasks within a wider context or understanding. In addition, a teacher needs to design tasks that require students to integrate information across individual lessons and class sessions.

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In sum, meaning in school subjects, especially at the secondary level, often resides in the concepts and principles of the disciplines. If skills are isolated from this propositional context and treated as interchangeable parts in the daily scheduling of lessons, then meaning is likely to be lost and students may not acquire flexibility and fluency in using their skills.

Classroom Processes That Govern Academic Work

The RCLT studies of academic work suggest that, in the daily routines of organizational life in classrooms, meaning can slip away or be pushed aside by other priorities and processes. In this section, we explore how this effect can happen by examining classroom processes that hold tasks in place and shape what students accomplish.

Work Flow in Classrooms

At the level of work flow in classrooms, there are striking differences between tasks involving familiar work and tasks involving novel work. When familiar work is being done, the flow of classroom activity is typically quite smooth and well ordered. Tasks are initiated easily and quickly, work involvement and productivity are typically high, and most students are able to complete tasks successfully.

Teacher 1's science class provides a good illustration of what happens when novel work and meaning are central parts of the curriculum of a class. In this case, the teacher spent a 6-week grading period on problem-solving and reasoning skills in units on the metric system and laboratory measurement and on scientific research methods. The students completed only 14 tasks (low for the sample of teachers we have observed), and 80% of total class time was devoted to only 6 tasks. Yet

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the task system in this class was tied together by a strong semantic thread. Tasks were closely interrelated and built upon one another in a careful, logical progression. In addition, the teacher often required students to apply concepts and procedures to novel situations and problems, thus pushing students to understand the content. All class sessions did not, however, score well on such production dimensions as goal-directedness, coverage, or productivity. Daily management of the class, especially in the areas of accountability, monitoring student progress, sustaining task involvement, and controlling time allocations was sometimes difficult. The teacher had a strong content system, but the enactment of this system occasionally had ragged edges.

This case and others in our data suggest that when novel work is being done, activity flow is slow and bumpy. In comparison with familiar work settings, introductions to novel tasks may be lengthy, and work involvement and productivity are sometimes low. Indeed, rates for student errors and noncompletion of work are high when novel work is assigned. Finally, students sometimes respond to the ambiguity and risk involved in novel work by negotiating directly with teachers to increase the explicitness of product specifications or reduce the strictness of grading standards. In sum, novel work stretches the limits of classroom management and intensifies the complexity of the teacher's tasks of orchestrating classroom events. In response to these pressures on work flow in the classroom, teachers may redefine or simplify task demands or they may reduce risk by softening accountability.

The Credit Economy of Classes

As this discussion suggests, accountability and credit weave a curious path through classrooms. In general, familiar work is subject

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to stringent accountability. Students are expected to hand in products of familiar tasks on time, and answers are judged strictly in accordance with definitions of correct and incorrect. At the same time, grades on familiar work often contribute heavily to term grades. Teachers appear to presume that familiar work is readily accomplishable by nearly all of the students and, therefore, students can be held strictly accountable for such work.

When students are assigned novel tasks, accountability is often suspended or at least softened. The rules for grading are less explicit and less clearly and stringently applied to finished products. Credit is often given for only the most tangential approximations of the requirements set out by the teacher at the beginning of the assignment. Moreover, students are often given repeated opportunities to obtain feedback before products of novel tasks are handed in for credit, and bonus points are often used to supplement grades in this area. Such practices create <u>surplus credit</u> that cushions the risk associated with novel work so that students will be encouraged to try these more challenging academic tasks.

Surplus credit appears to be an important mechanism teachers use to sustain a complex work system in classrooms. It remains to be seen whether there are negative side effects of softening risk for novel work. A reasonable argument can be made that a credit economy in which risk is minimal for novel work and strict for familiar work communicates a clear sense of where students should spend their time and intellectual resources.

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The Curriculum as Lunar Landscape

We have used the metaphor of a lunar landscape to summarize the general features of work systems in classrooms. The curriculum is enacted in classrooms as a crater-filled terrain in which students encounter gaps of various magnitudes, gaps which must be crossed by processing information. These gaps are often quite narrow, such as those that can be crossed by using a two-step computational algorithm in math or by remembering the spelling of words on a list. Sometimes the gaps are wider, such as those involved in novel tasks: writing essays, solving word problems, applying a scientific concept to an unfamiliar problem or designing an experiment.

Progress through the curriculum is generally efficient when the craters are small. When a crater is large, students frequently hesitate at the rim. That is, many have a difficult time getting started with the assigned work. In addition, error rates increase and completion rates decrease. These conditions create workplace tensions in a classroom between the academic task system and the demands for pace and momentum that reside in the system of social order in classrooms. Teachers often respond to such tensions either by redefining gaps to make them smaller or by throwing a net under the gap in the form of bonus points or easy grading to encourage students to take the risk of leaping. In the process of helping students across large craters, teachers sometimes reconstruct the work they would have students accomplish and, thus, redefine the curriculum in the classroom.

There is an important message here for teacher evaluation. If the criteria for judging teaching place overriding emphasis on clarity, engagement, and order, it is possible that teachers will avoid ambiguous

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tasks because of their impact on classroom efficiency and productivity. Teachers will be forced, in other words, to smooth out the work system in advance, emphasize only skills and guided practice, and avoid tasks that require students to struggle with meaning. In such management-driven classes, it is possible that meaningfulness and higher level processing of subject matter will be pushed aside. We clearly do not intend to say that inefficient instruction is necessarily meaningful or effective, or that ambiguous tasks can be productive if students are not given explicit preparation in advance. The point is, rather, that evaluation must be sensitive to the overall purposes of instruction in a particular class and to the effects of different types of academic work on classroom processes.

Students' Interpretations of Academic Work

It is not always possible to tell, of course, whether students have accomplished tasks in the way a teacher intends. Some circumvent task demands by copying work from someone else or by guessing at answers. At a more serious level, some students misinterpret assignments or use inappropriate strategies and inaccurate information to get work done. For example, a student might always subtract smaller numbers from larger numbers regardless of their order in arithmetic problems (see Brown & VanLehn, 1979) or never really understand how plants get their food or how light enables people to see (see Eaton et al., 1984), even though the student completes tasks "correctly" enough to go unnoticed by the teacher.

A student case from the combined English and social studies class taught by Teachers 7 and 8 is useful in gaining insight into students' interpretations of task demands. The reader will recall that the

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analysis in this class focused on a 4-week unit on Indians of the region. In the Indian unit, the students were to do independent readings on tribes of their own choosing and reflect this information in their products. The writing assignments included two descriptive paragraphs and an analytical paragraph (comparison and contrast or cause and effect). The teachers described these assignments in class in terms of both their substance and their form. Substantively, students were to learn about a tribe or tribes and use this information to describe some aspect of their life, compare and contrast two tribes, or show how some factors, such as environment, had an effect on their lives. The format of the paragraphs were described in terms of their elements: topic sentences, descriptive terms, supporting arguments, clincher sentences. In addition, the teachers presented a fictitious tribe to model how information could be assembled to construct paragraphs.

One student who was interviewed adopted a procedural interpretation of the writing assignments. He saw the work as essentially a process of turning notes into paragraphs, and he was confident that he could do this. He also used a search-and-match strategy in which he looked for existing texts that seemed to match what the teachers had in mind for the assigned products. At the same time, his interpretation excluded substance. He had little interest in or knowledge about Indians and did not appear to think that gaining such knowledge would be at all helpful. Rather, he found a text that was close to the teachers' specifications and then used it to finish the product. This student saw the teachers' example of a fictitious tribe as a very useful illustration of the procedures he was to follow in turning notes into paragraphs.

In contrast, another student adopted a more substantive orientation

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to the unit. She thought she was supposed to learn about Indians. She saw little relevance for the fictitious tribe example because it did not contain information about a real Indian tribe that she could use in writing her paragraph.

The weaknesses of a procedural interpretation of the work became apparent in the final products. The first student was unable to write topic sentences or order his arguments well without knowledge of Indians. He even failed to select a text that adequately matched the teachers' specifications for the assignments. The student had difficulty understanding why his performance was unacceptable, however, because he thought he did what he was supposed to do.

Although this procedural interpretation of the writing assignments was narrow and did not accurately reflect all that the teachers said about the assignments, there were some grounds for this approach. The writing assignments were discussed in terms of their formats and elements, and the fictitious tribe example implied that substance was irrelevant. Moreover, the class did not discuss and was not held accountable for a common body of knowledge about Indians, a factor that also pushed substance into the background. In the end, some of what the teachers did in class could have led to a procedural interpretation of the assignments.

This case also illustrates that students may import from previous classes models of how to do tasks. In other words, they develop task response systems for particular types of assignments, such as essays, word problems, and science labs. We suspect that these imported models are used most often for novel work because specifications are necessarily less explicit for such tasks. Teachers may need to pay

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particular attention to the effects of prior learning when introducing novel tasks.

Summary

The RCLT studies provide a rich and detailed picture of how curriculum, social order, management, instruction, and learning intersect in classroom events. The concepts and general propositions that emerge from this research can sensitize teachers and supervisors to an essential dimension of classroom life, namely, the academic work system in a class. This dimension has immediate impact on how students experience subject matter and, therefore, what they learn in school. Attention to this dimension in teachers' planning and in staff development and curriculum design is likely to have long-term implications for student achievement.

In addition to practical knowledge at a level of general descriptions and propositions, the RCLT studies have also provided a foundation for practical suggestions concerning management of specific aspects of work systems in classrooms. The following chapter contains a discussion of these management problems and suggestions.

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III. Practical Suggestions for Managing Academic Work

Our discussion of classroom processes associated with academic work to this point has suggested that the teachers' job of translating a curriculum into academic work for secondary students is complex. The MAT studies and related research have practical implications for instructional supervisors and teachers. Some of these implications--such as the recommendation that supervisors must consider the nature of tasks students are working on when evaluating a class on such indicators as student engagement, efficient time use and smoothness--have already been discussed. This chapter focuses on other implications for practice by describing some of the problems teachers face in planning and conducting classwork and suggesting strategies for dealing with the problems.

Communicating Tasks to Students

One problem suggested by academic work studies is that of communicating the task to students so that they understand what they are supposed to do and how they are supposed to do it. Students often misinterpret their work and its purposes. Sometimes these misinterpretations are linked to previous student experience or preconceptions about a type of task. In addition to the examples described in Chapter II, Nespor (1985) has described how one capable student in an MAT English class failed to complete a persuasive essay assignment because he could not reconcile the teacher's requirements with a model of a persuasive essay he had been taught in the previous grade. In other cases misinterpretations occur partly because of the way tasks are defined by teachers. When assignments are not explained clearly or when there are a large number of procedural requirements

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students may focus on relatively unimportant aspects of the task. In presenting assignments, particularly novel ones, teachers therefore need to clearly explain the assignment and the steps and strategies students are supposed to use in completing it. Providing a model of the end product helps in many cases, but explaining or demonstrating each step in how the model was produced is equally important. Of course, how explicit the model and explanation of steps should be depends on the goals of the assignment. If originality, creativity or independent problem solving is a major goal, providing a model and explicit steps may be counterproductive. In such cases reviewing for students the products and steps associated with previous, preparatory class activities may help, and directions for the new task may emphasize general processes and the objectives or purpose of the task.

In explaining most assignments teachers should call students' attention to the goal or purpose of the assignment and explain the grading criteria to be used. Research has shown that students' expectations of how work will be evaluated shape their attention to the task and the strategies they use in doing it. This suggests two considerations. First, announced evaluation criteria should be closely tied to the major purposes or goals for the task, even though these goals may be relatively difficult to evaluate objectively. In long-term assignments, students may need to be frequently reminded of the purpose and criteria. Second, teachers may be wise to announce a small number of grading criteria that emphasize priority objectives for the assignment, rather than to formulate a complex list of procedural or content requirements affecting students' grades. Presenting a complex

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list will probably increase the chances that some students will misinterpret the task or focus their efforts on a minor aspect of it.

Because students' prior expectations and preconceptions can play such an important role in how they interpret tasks, it is clear that teachers need as much as possible to begin with some understanding of their students' prior experiences with both the content and the task type. In the initial presentation of an assignment to students teachers might address and challenge or correct students' preconceptions. Obviously teachers' ability to do such is limited. They cannot know what all of the students' experiences were in different classes, but in some cases teachers have such information. For example, an English teacher may know that the persuasive essay is commonly taught differently from that teacher's version or is taught as a particular form by another teacher at a lower grade level at that school. Or, a science teacher with stringent requirements for thoughtful interpretations of results in science laboratory reports may anticipate that sophomore students will have had very different experiences with laboratory reports in junior high school. Calling explicit attention to such differences during explanation of assignments may be helpful.

Monitoring Students' Work

One of the clearest messages emerging from studies of classwork at both elementary and secondary grade levels is that teachers must carefully monitor students' understanding of their work and their strategies for getting it done. Anderson (1981) and others who have examined student work in elementary grades, as well as the MAT studies of secondary classrooms have shown that students often produce products without understanding what they are doing. In some cases they use

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incorrect strategies to produce "acceptable" papers, thereby reinforcing their misconceptions of the content. Clearly, teachers need not only to examine student papers with a critical eye, but also to observe students carefully and question them about their work. If a teacher focuses only on whether students' answers are completed or "correct" rather than on the thinking used to obtain the answers, mistakes and misconceptions can go unnoticed and uncorrected. Indeed, one of the major tasks of a teacher is to monitor how students are doing academic work by asking strategic questions to make explicit a student's level of understanding of the task and the content (see Anderson, 1981; Bennet-Desforges, Cockburn, & Wilkinson, 1984; Erlwanger, 1975).

Strategies for Monitoring

Monitoring to catch students' misinterpretation of tasks and misconceptions of content presents real challenges to teachers. Often, spotting student misconceptions requires a thorough and sophisticated understanding of the content. The greatest limitation for most teachers, however, is time. Elementary teachers cannot possibly monitor every student in every assignment, and in secondary schools where teachers may have 150 students the problem is equally difficult. Another complication in secondary schools is that much work is done outside of the classroom. Some monitoring strategies are helpful however. First, in major long-term assignments in secondary schools teachers usually can make opportunities to confer individually with each student sometime near the beginning of the assignment. They may require students to turn in an outline or plan before the conference. Second, during classwork teachers need to acquire the habit of frequently asking students to explain their answers, correct or incorrect. They may ask,

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"Can you show me how you got this answer? Where did this number come from?" They may ask students simply to describe an assignment in their own words or to explain what is imporant about a particular assignment. During work or content development activities students should be required to explain concepts in their own words, giving original examples. Teachers need be on guard for students' parroting definitions or examples provided in class or in the text book. These responses may mask lack of comprehension. In addition, during activities such as science laboratories, it is a good idea to ask individual students to explain the procedures they are using and the reasons for particular procedures.

A third source of information about student understanding that may be overlooked by many teachers is student/student interactions about their work. Unobtrusive observation of students as they work together or talk to each other about assignments can often reveal misconceptions or misunderstanding. Observers in the MAT studies frequently noted students providing other students with inaccurate, misleading or incomplete explanations or directions, and listening to student interactions sometimes showed that there were wide-spread misunderstandings of which the teacher was unaware.

Monitoring Group Work

Some types of tasks or ways of managing tasks create special monitoring problems. For example, if as in many secondary classrooms, a teacher's main source of information about all students' understanding of content is their products such as homework and daily quiz papers, then routinely allowing students to work together in groups or informally assist each other on assignments makes it difficult for the

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teacher to know who is completing the work on their own and who cannot. Private questioning of individual students and careful observation of group interaction are important. In addition, assessment of student performance on some independent practice tasks should supplement such group work. We will discuss this point in more detail in the following section.

Encouraging Students to Engage in Novel Tasks

In Chapter II we described how conducting novel tasks, those less routine assignments with comprehension-level objectives, presents teachers with special challenges in managing class activities and motivating students. Compared with routine work, students have a more difficult time getting started on novel assignments. They make more errors and more often fail to complete the assignment. Students may complain and persist in requesting clarification and assistance even when the teacher has provided preparatory instruction and clear directions. Novel tasks can be difficult for the teacher as well as for the student. In this section we make some suggestions for dealing with such problems, based on our observations during the MAT and a special study of comprehension-level tasks conducted in six of those classrooms (Sanford, 1984). Some of our comments are not data-based, but represent what we think are reasonable strategies for dealing with the complex problems we observed.

Anticipating Student Responses

First, it is a good idea for a teacher to have a very clear notion of the priority objectives for a task before presenting it to students. Novel tasks, especially long-term ones such as major writing assignments or research projects, frequently get reshaped or reduced during the time

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between their initial assignment and return of graded products to students. Therefore, before announcing a task a teacher might try to decide what aspect of the task is most important for students to engage in and which aspects are more expendable. In answering students' questions, correcting their work in progress, and providing assistance, the teacher will inevitably be doing some of the students' work for them. Deciding ahead of time what piece or pieces of the work must be left to students puts the teacher in a better position to manage interactions with students about the task thoughtfully and proactively.

Second, a teacher should watch for student efforts to change or reduce a task by getting the teacher to be more explicit, supply more explicit models or other resources, soften accountability or give more assistance. The students' requests and resulting task changes may be reasonable and necessary, but awareness will help the teacher, rather than the students, stay in control of task definition.

Providing Safety Nets

The MAT studies showed that in a variety of ways teachers provide safety nets that encourage students to engage in challenging work. These are management strategies that make a novel task less risky or in some way mitigate the difficulties of the task for students. These strategies need to be chosen carefully however, with awareness of the effects that different strategies can have on task demands and on the teacher's ability to monitor students' work.

Revise and resubmit. One strategy we observed in use with major tasks in two classrooms is that of allowing students to revise or redo their work with little or no grade penalty after they have handed it in for a grade and received benefit of the teacher's comments. For

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example, in one high school science class an independent research project was graded in a series of sequential steps, including four to six steps each 6 weeks. Students turned in each step as they completed it and before proceding to the next. Each step was either accepted or turned back to the student for revisions, with changes indicated on the paper or directions to confer with the teacher. Students were allowed to submit each step as many times as necessary, and acceptance brought full credit for that step. In a social studies class students who did poorly on any major assignment were allowed or required to do it over, utilizing feedback from the teacher with no grade penalty. This grading policy does add to the teacher's burden of grading and commenting on papers, and we noted a few students who seemed to take unfair advantage of the system, but it is a strategy that can result in holding all students accountable for attempting novel work and meeting some standards of performance.

Working together. Allowing students to pool their efforts on novel tasks is another way of softening individual student risk. Carefully structured, cooperative work groups have additional potential of building social interaction skills, improving social relations, and fostering a cooperative rather than competitive social climate (for a discussion of use of cooperative learning groups in the classroom see Slavin, 1980).

In MAT classes a variety of forms of peer cooperation were observed. One teacher simply allowed and encouraged students to get help from other students during class on most assignments. Others used grouped or paired work arrangements in which students worked together on procedures and on content to varying extents, but turned in individual

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reports or worksheets for a grade. In a variation seen in one class, students worked individually on a task first (e.g., they completed a set of complex genetics problems for homework) then after papers were checked by the teacher for completion only, students discussed and corrected their work in peer groups before turning in papers. In some cases students turned in a single group product for grading, although each student was to have completed the work. The teacher randomly selected a student's paper from each of the groups for collection and all group members received the same grade. As another example, in a social studies class students worked in groups of four or five to prepare presentations on an assigned topic. Their assignment required that they cooperate in information gathering and synthesis, writing, planning and presentation to class. Students in each group shared a single grade.

All of such arrangements for peer assistance and group work have the effect of softening the burden of individual student performance and risk and, especially when decisions about group composition are made carefully by the teacher, these arrangements can encourage students to engage in novel tasks and learn from each other. There are a number of problems associated with group work however. Small group activities are relatively complex to manage, making it difficult for teachers to maintain order, efficient time use, and steady task focus. A more critical problem from the perspective of academic work, however, is that the use of group work and peer assistance reduces the teacher's ability to monitor individual student performance and understanding. If students are not required to attempt work on their own or show or discuss their work with the teacher, diagnosis of individual students'

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misconceptions or sources of confusion is impossible. Sometimes misconceptions are fostered in group work, as students share their confusion with one another. Some students manage to avoid or circumvent the work altogether and don't get practice with the targeted content or skill. Monitoring strategies such as those outlined in the preceding section are clearly in order for tasks accomplished in group settings. In addition, such tasks should be supplemented by tasks that hold students accountable for some independent practice and mastery, as well.

Adjusting grading systems. As we have noted teachers often help students cope with challenging work by adjusting grading or accountability systems to lessen risk. In constructing exams, they may balance difficult or unfamiliar content with easy or very familiar content. They may also grade tasks in such a way that higher level components count less than memory or procedural components, so that lack of success on the higher level components does not result in failing grades. Another strategy we have already mentioned is that of creating a cushion of surplus grade credit by providing extra credit assignments, including extra credit questions on tests or even providing "free points" to inflate all grades. Some teachers award participation grades based on students' efforts during class discussion and on consistent completion of assignments. All of these strategies may compensate for poor student performance on riskier tasks. Extra credit assignments have the added feature of also providing opportunity for teachers to entice students to struggle with particularly challenging content. One teacher we observed used a strategy called the "no risk pop test." Students received extra credit for perfect papers or for every correct answer, but received no penalty for incorrect answers.

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Another grading strategy often used with minor tasks is that of awarding credit for task completion only, not accuracy, especially when students' ability to perform the task with accuracy is unlikely. The completion or effort grade strategy brings up a critical issue--that of the importance of maintaining the often fine line between mitigating student risk (to encourage and support student efforts) and suspending student accountability for novel work altogether. As we have noted earlier, research suggests that students' expectations about how their work will be evaluated influences how they process information and do their work. Suspending accountability for novel work or comprehension-level components of work by grading consistently on only completion or by accepting any student response to comprehension-level questions does not appear to encourage students to take novel work seriously. To illustrate, lab reports in one of the science classes we observed were checked only for format and loosely for completion, and students midyear work suggested that they were well aware that the content of their reports made little difference. Questions that required analysis or inference were frequently skipped or answered with little thought. Teachers that are more successful in getting students to engage in novel work maintain at least an aura of accountability around the work. Their usual grading practices and statements about class work convince students that the work is important and to be attempted seriously. In such classes, occasional use of completion or effort grades or other "safety nets" does not alter students' general expectations that they will be held accountable for serious effort.

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Making Connections Among Classroom Tasks

In the discussion of meaning in classroom work in Chapter II we pointed out that teachers might help students perceive the meaning of their academic work by focusing on content connections that tie tasks together. A brief discussion of ways that teachers can do this is in order here.

First, when assignments are introduced, explicit statements can be made about relationships between the current work and preceding tasks. Where a task builds on earlier work, the teacher may say something like, "Remember last week when we learned the rules for _____ and practiced with them on a worksheet? Today we are going to apply those rules in writing a _____." In other cases tasks may be related because they give students experience with different examples of the same concept or different methods or procedures for accomplishing similar ends. Brief statements about connections in task purposes and development of major strands of content are recommended. Teachers can also ask questions that require students to recall content of previous tasks, either at simply a recall level ("Where have you seen a problem like that before?") or by applying a newly introduced concept to material from a recent task.

Stating relationships among tasks is one way teachers can help students make sense of their work. A more fundamental consideration, however, is that logical conceptual relationships across tasks need to exist. A hodge podge of assignments based on materials at hand does not lend itself to an emphasis on meaning. Obviously building a meaningful system of tasks requires care in unit and long-term planning as well as understanding of the content and curriculum goals.

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A strategy that teachers can use in planning is to plan to culminate units or blocks of class time with tasks that require students to review and integrate work from previous assignments. Such tasks commonly take the form of unit tests. Review and preparation for such tests should entail discussion of content and products of the tasks leading up to the unit test. Too often, review consists of students filling out a worksheet that closely resembles the test, where worksheet completion does not require them to revisit their completed tasks. In contrast, review that includes examination and discussion of students' completed work is one way to emphasize meaning while providing students with feedback about their performance. If this discussion is a direct and necessary resource for an ensuing task--the unit exam--students are likely to engage seriously in the review of their work. An incidental strategy implied here is that it is a good practice tc require students to keep their graded work in a notebook so that they can refer to it later.

Choosing Task Types and Forms

A fundamental problem suggested by studies of academic work is that of making wise decisions in selecting or designing classroom tasks. This problem encompasses much of what teaching is about, and we will not attempt to describe all considerations here. Instead, in the following section recommendations are made about two imporant issues: first, the match between tasks and their intended learning objectives, and second, task variety.

Matching Tasks and Objectives

One of the lessons emerging from the MAT studies is that academic work often falls short of its intended or announced objectives.

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Questions intended to require students to demonstrate that they have read and comprehended a chapter may show only that they can locate and copy phrases in bold print. A laboratory activity chosen to help students understand an important biological process may in fact be limited to an exercise in following complex procedural directions and copying a report format from the chalkboard. Finally, a writing task meant to provide students practice in expressing an idea coherently in a paragraph may actually never go beyond a sentence completion or example generating exercise.

Occasional mismatches between the task as enacted and the learning objective or goal are unavoidable, given the complexity of classroom settings and teaching. The MAT suggests some potential solutions, however. First, it would appear that the question which teachers need to be able to ask themselves and answer when planning is not simply, "Will this task contribute to this learning objective?" but, "Will this task conducted in this way contribute to this learning objective for students?" Answering the second question requires that teachers understand classroom processes highlighted in this report and that they focus on what students actually do and are held accountable for in each task.

Also implied is that teachers must have a good understanding of the curriculum goals. Often understanding of certain higher order goals is lacking, even among experienced teachers. For example, one teacher in our junior high task study stated that one of her main goals in her science class was to teach students to use scientific and experimental methods. This was her rationale for having students engage in many laboratory activities and an independent research project. Yet,

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observations of these tasks indicated that this teacher had little understanding of these science learning goals. In content areas where certain higher order objectives are deemed critical, staff development activities should be structured to ensure that teachers share an understanding of those goals and expectations for students.

Another consideration in choosing tasks was implied in our comments about communication of tasks and their grading criteria. We noted that announcing a large number of requirements or specific grading criteria for a task may increase the danger that students might focus their attention on relatively unimportant aspects of the work. This suggestion was inspired by Phyllis Blumenfeld, who has noted that when students work on tasks that require complex procedures or social arrangements the chances are great that they will be distracted from the content or main learning objectives of the task. She has recommended that, therefore, when teachers are introducing students to difficult or unfamiliar content simple forms of tasks are probably best. By simple forms we mean those that do not require students to follow many procedural steps, use complex equipment, or do a lot of planning or organizing not essential to the main learning objective. We think this is a useful notion and a strategy worth considering when a teacher has had difficulty conducting work with particular content.

Task Variety

The preceding paragraph might seem to imply that simplifying all tasks to facilitate management would be a good idea. On the contrary, studies of classwork at all grade levels provides too much evidence that many teachers do not give students enough variety of opportunities to practice different cognitive operations and social skills or to

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encourage them to be flexible in their approach to work and use of knowledge. In many classes students work day after day on assignments that use the same narrow set of procedures and types of learning objectives. In view of this fact we recommend that teachers take a hard look at the kind of work they assign. They might survey their lesson plans, grade books, and collections of student papers to reflect on the following questions. What operations do students practice in this work? How routine or repetitious are the assignments? How much of the work really requires students to organize information, make choices, express themselves, apply what they know? In other words, do students encounter any novel tasks in this class? What kind of general picture of schoolwork or learning in this content area do these collective assignments give?

In assessing the overall picture of tasks in a class, tests should not be overlooked. Written tests are tasks, tasks that convey important information about the task system in most classes, because accountability is generally higher for students' test performance than performance on other tasks. Routine testing practices in a class are likely to affect what secondary students pay attention to and how they process information. In most, but not all, subject areas and classes careful examination of students' written test papers can give important information about what students are learning to do with the content.

Summary

This chapter has reviewed many of the complex problems teachers face in planning and conducting academic tasks in secondary classrooms. Suggestions have been made for strategies in communicating tasks, monitoring students' work, encouraging their efforts at novel tasks, focusing on connections between tasks, and selecting different types of

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tasks. Our intention in the final section was to encourage teachers to reflect on the variety of tasks they provide for students. However, scanning lesson plans and examining test papers as we suggested would not be sufficient for a supervisor or teacher to get a wholly accurate picture of work in a class. The reader will remember from our discussion in Chapter II that information about classroom events and processes, especially about the resources students use in doing their work, must be gathered and considered as well. To illustrate, problems or questions on a particular test paper may appear to require comprehension-level operations, but if identical problems were previously worked by the teacher in the class and copied by students, the test problems may measure only students' recall of the material, not their ability to solve a type of problem. Thus, supervisors and teachers wishing to assess academic work in a class are encouraged to attempt systematic observation using the task framework of the MAT. In the chapter that follows, guidelines and specific procedures are recommended for observing and analyzing academic work.

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IV. Procedures for Observing Academic Tasks in Classrooms

One of the clear messages of the RCLT studies is that understanding academic work requires careful observation and analysis. Isolated recording of a limited number of dimensions is simply not sufficient to capture the curriculum in use in a classroom. Observations must focus, rather, on how teachers define assignments for students, what resources they provide to them, and what they hold students accountable for. In addition, it is necessary to visit a class on consecutive days to trace the development of work over time. Assessing the quality of academic work requires careful observation and analysis, and improving the quality does not lend itself to a "quick fix."

The purpose of this last chapter is to provide instructional supervisors and teachers with some ground rules for observing how academic work is conducted in a class. The steps we describe for a pre-observation conference, observation and notetaking, examination of student products, analysis of tasks, and postobservation conference closely follow the procedures used in the MAT. Of course, decisions about specific procedures, choice of tasks, length of observation periods, and the nature of postobservation conferences will depend on the specific purposes for the observations. As we indicated in the introduction to this report, several different applications of this approach to observing classrooms are possible. First, this approach might be used as a way of assessing or monitoring a curriculum program. For example, an instructional coordinator might wish to evaluate the curriculum experienced by students in an honors class that has specific types of learning objectives. Second, observation of academic work might be used primarily as a source of feedback and a discussion

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framework for a teacher engaged in a professional development effort. For example, a support teacher or supervisor might observe several tasks in a beginning teacher's classroom and use the task analyses in a midyear discussion with the new teacher about planning and conduct of classwork. Finally, an individual, experienced teacher might wish to modify procedures to examine his or her own students' learning experiences systematically. In any case, the observer must first understand the concepts and principles discussed in the previous sections of this report.

Identifying Academic Tasks

The RCLT system for describing and analyzing tasks centers on the products students generate for the teacher (such as tests, completed worksheets, papers, oral reports, etc.) and on the events leading up to the creation of these products. A student product, in other words, signifies the completion of a task. Once these terminal points are identified, information about how the product was first defined for students, how it was talked about during work time, the quality of student' final efforts is analyzed. This retrospective approach complicates the job of observing tasks because it is often difficult for an outside observer to tell at any given moment how classroom activities or information will eventually be used to define or accomplish a task. This problem is especially serious for tasks that are accomplished over several class sessions. The following section contains information about how observations can be structured, focused, and analyzed to pick up necessary information about academic work.

Three major data sources are used to obtain information about academic tasks in a class. The first is a running narrative record of

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what happened in the classroom, with particular attention to information about what the assignments are and how they can be completed. Copies of assignment sheets, worksheets, textbooks, and other instructional materials are an integral part of this narrative record. This information is essential to understanding how work is structured in a class, how it might change over time, and what resources are available to students as they accomplish the work. A second and equally important source is students' completed papers, tests, worksheets, etc., after they have been graded by the teacher. With this information, it is possible to see what students actually are required to do and how the teacher reacts to their products. Third, interviews can be conducted with the teacher and selected students to gain information about their perceptions, intentions, and understandings of the work. Each step in the process of observing and analyzing tasks is explained below.

Pre-observation Conference

Before attempting to observe academic tasks in a class, it is often helpful to talk with the teacher about the kinds of work that students are assigned to do. The purpose of the conference is to provide a broad picture of the work system in a class, get information about the academic goals the teacher is trying to accomplish, and identify possible tasks for observation. This information can increase the efficiency of classroom observations because they can be scheduled around a particular task or tasks of interest. Depending on the purposes of your observations, a task of interest might be one that is aimed at a particular skill (e.g., writing a paragraph) or area of content (e.g., experimental design) that is considered critical in the curriculum. Or, you may be interested in observing a variety of

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relatively short-term tasks to get a picture of how a teacher organizes student work around several topics and of the range of cognitive operations required of the students. In either case, you will want to schedule observations to include the beginning (initial announcement) of a target task, and you will need to make several consecutive observations to avoid missing important information about the development of the task. Our experience suggests that 3 consecutive days are probably the minimum required.

A pre-observation conference will not necessarily be easy, nor will it always give a complete and accurate picture of a task system. We have found that teachers are not always experienced in describing the academic work they require students to accomplish. There are several avenues to explore in drawing attention to academic work. It is often useful to begin by asking a teacher to describe the content units they are currently teaching and the assignments students will turn in during the next week. From there, it is possible to probe specific assignments to determine how they are presented to students and how students accomplish the work. Another good strategy is to focus on the categories a teacher uses to organize her or his grade book. Grade books will often reveal the major strands of work in a class for a grading period. These can then be used as a framework for exploring in greater detail the work that is currently being done.

Observations of academic work can, of course, be conducted without a pre-observation conference. In such circumstances, however, it will be necessary to talk with the teacher afterward to obtain an overview and history of the work system in the class and to get inforamtion about

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the teacher's goals and objectives for the content unit and specific assignments observed.

Observing Classes

In constructing a running account or record of class sessions, an observer must concentrate primarily on information that defines the nature of students' products and the conditions under which they are produced. Areas for special attention include:

1. Teacher's directions (written and oral) for assignments. Pay particular attention to formal statements the teacher makes about the nature of assignments and the requirements for completing the work. Copy down such information if it is written on the chalkboard. Also, collect copies of assignment sheets or worksheets that are handed out to students, and inspect textbook sections used for the work. Record both the teacher's responses to students' questions about work and, during work time, informal comments that seem to define or alter the nature of an assignment. In essence, you want to be able to describe the requirements for a task as these are announced to students during the course of working on a task. A useful frame of mind is to imagine that you are a student in the class and ask yourself whether and how you know what to do and how to get it done.

2. Resources made available to students in the forms of textbooks or other resources, hints or clues for accomplishing parts of assignments, presentations on related content or demonstrations of how to do similar tasks, models of finished products supplied by the teacher or by students, and opportunities to discuss work with other students or get interim help from the teacher. Also, note whether students can consult notes taken previously or see posters, chalkboard messages, or

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other sources of information related to accomplishing a task. If work is corrected in class, note if it possible for students to write their answers during or after this activity.

3. Statements made about grading policies and accountability for work. Record any comments the teacher makes about whether a product will be graded, how much weight it will have in calculating the grade for the term, and what particular features of the product are most important. Also, note whether bonus points or extra credit is available for use with the assignment.

4. Examine student work to determine (a) the correspondence between stated task requirements and the final products, (b) patterns of students' errors or areas of difficulty, and (c) evidence that prompts and other resources were used to complete work. If possible, try to see the work after it has been graded by the teacher so that it will be possible to learn what the teacher accepted as appropriate products and how different components of the task were graded.

Describing Tasks

Once information about classroom events, resources, and student products has been gathered, it is a good idea to try to construct a formal description of the task observed. As noted, this analysis begins with the end point of a task, namely, the product handed in for teacher inspection, and then follows the product from its initial description to this end point. The following questions are useful guides for this analysis:

1. What was the assignment, that is, what were the "official" or "announced" requirements for the work? How did the assignment fit into

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the content unit and the general work system (e.g., it was the major task of a unit on _____)?

2. What changes occurred in the definition of the work during the time students spent completing the assignment? (e.g., Were requirements softened by the teacher or different grading criteria announced?)

3. What prompts, models, direct instruction or other resources were made available to students during the course of working on the assignment?

4. What questions did students ask during the class and what answers did they receive that appeared to affect the nature of the work that was done?

5. What means of accountability were used in conjunction with this product, including both announced standards as well as actual grades given? For what aspects of the task were students actually held accountable?

6. How successful were students in meeting the requirements of the task? Were there certain aspects of the tasks on which students had particular difficulty, and can their difficulties be traced to any classroom event?

Postobservation Conference

A conference with the teacher after tasks have been analyzed can serve two important purposes. First, additional information concerning the teacher's work system in the class can be obtained. Such information can be obtained by asking the teacher about major purposes, grading policies, and standing patterns or routines in the class. Questions in this area should build from the task or tasks observed so that the overall reference is to concrete aspects of the work in the

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class. In some instances it might be possible to interview selected students about a specific assignment to determine how they interpreted the work. This additional information about tasks can help to place tasks in context and interpret observed tasks.

Second, the post-observation conference provides an opportunity to discuss academic work with the teacher and, if necessary, explore possible avenues for improvement. A conference at this level is at the core of clinical teacher education. It is here that the practical lessons from the Managing Academic Tasks Study--the general concepts and propositions about academic work presented in Chapters I and II and the practical suggestions discussed in Chapter III--can be connected to the specific circumstances observed in the class.

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References

Anderson, L. (1981). Student responses to classroom instruction (Res. Series No. 109). East Lansing, MI: Michigan State University, Institute for Research on Teaching.

Anderson, L. M. (1983). The environment of instruction: The function of seatwork in a commercially developed curriculum. In G. Duffy, L. Roehler, & J. Mason (Eds.), Comprehension instruction: Perspective and suggestions. New York: Longman, Inc.

Bennett, N., Desforges, C., Cockburn, A., & Wilkinson, B. (1981). The quality of people learning experiences (Interim report). Lancaster, England: University of Lancaster, Centre for Educational Research and Development.

Brown, J. S., & VanLehn, K. (1979). Towards a generative theory of "bugs". Palo Alto, CA: Xerox Palo Alto Research Center, Cognitive and Instructional Sciences.

Chi, M., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices (Tech. Rep. 4). Pittsburgh, PA: University of Pittsburgh, Learning Research and Development Center.

Davis, R. B. (1983). Diagnosis and evaluation in mathematics instruction: Making contact with students' mental representations. In D. C. Smith (Ed.), Essential knowledge for beginning educators (pp. 101-111). Washington, DC: American Association of Colleges for Teacher Education.

Doyle, W. (1983a). Academic work. Review of Educational Research, 53(2), 159-199.

64 BEST COPY AVAILABLE

Doyle, W., Sanford, J. P., French, B. S., Emmer, E. T., & Clements, B. S. (1985). Patterns of academic work in junior high school science, English, and mathematics classes: A final report (R&D Rep. 6190). Austin: University of Texas, Research and Development Center for Teacher Education.

Eaton, J. F., Anderson, C. W., & Smith, E. L. (1984). Students' misconceptions interfere with science learning: Case studies of fifth-grade students. Elementary School Journal, 84, 365-379.

Erlwanger, S. H. (1975). Case studies of children's conceptions of mathematics--Part 1. Journal of Children's Mathematical Behavior, 1, 157-283.

French, B. A. S., & Sanford, J. P. (1985). Academic tasks in high school biology: A genetics unit (R&D Rep. 6197). Austin: University of Texas, Research and Development Center for Teacher Education.

Greeno, J. G. (1983, April). Skills for representing problems. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Heller, J., Reif, F., & Hungate, H. (1983, April). Toward theory based instruction in scientific problem solving. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Mitman, A. L., Mergendoller, J. R., Packer, M. J., & Marchman, V. A. (1984). Scientific literacy in seventh-grade life science: A study of instructional process, task completion, student perceptions and learning outcomes. San Francisco, CA: Far West Laboratory for Educational Research and Development.

BEST COPY AVAILABLE

Sanford, J. P. (1985a). Academic tasks and research in science teaching (R&D Rep. 6196). Austin: University of Texas, Research and Development Center for Teacher Education.

Sanford, J. P. (1985b). Comprehension-level tasks in secondary classrooms (R&D Rep. 6199). Austin: University of Texas, Research and Development Center for Teacher Education.

Sanford, J. P. (1985c). Science classroom management and organization. In C. Anderson (Ed.), Observing science classrooms: Perspectives from research and practice. Columbus: Ohio State University, ERIC Center for Science, Mathematics, and Environmental Education.

Slavin, R. E. (1980). Cooperative learning. Review of Educational Research, 50, 315-342.

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